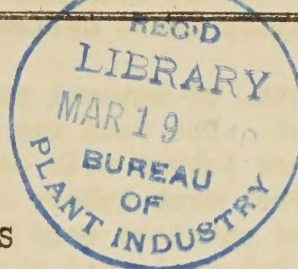


THE · EXTENSION PATHOLOGIST

A NEWS LETTER FOR EXTENSION WORKERS INTERESTED IN PLANT DISEASE CONTROL

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REPORT ON POTATO BACTERIAL RING-ROT

At the joint session of the Potato Association of America and the American Phytopathological Society at Columbus, Ohio, December 30, 1939, four papers on bacterial ring-rot and its control were given, and the report of the potato-disease research committee, which dealt mostly with this disease, was read. Notes on the four papers and on some of the discussions, suggestions on control, and the report of the potato-disease research committee are given in this issue of The Extension Pathologist.
--R. J. Haskell.

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A Promising Method of Eliminating Bacterial Wilt (Ring-Rot)

C. H. Metzger, and D. P. Glick
Colorado State College, Fort Collins, Colo.

Nineteen lots, of several varieties each, nearly free from the disease, were selected. The seed was treated with Semesan Bel, cut with disinfected knives, and tubers with any vascular discoloration were discarded. Smears were made from each tuber; and after microscopic examination all apparently infected potatoes were eliminated, the cut seed pieces were dipped in Semesan Bel again and planted in tuber units. During the growing season, stem smears were made and all suspicious units were rogued. The healthy tubers will be offered to foundation seed growers. In the 19 lots, 4,880 tubers were examined, and 1,025 (21 pct.) were discarded. Of 1,684 vines examined, 5 percent of the smears were positive; 11 percent of the units were discarded.

Using a similar method, it is believed that a grower at Divide has secured a crop free from bacterial ring-rot.

Potato Ring-rot Spread, and Its Control by Disinfectants

G. H. Starr
University of Wyoming, Laramie, Wyo.

"Experiments conducted in 1939 at Laramie, Wyo., showed corrosive sublimate to be the most effective, Mercurnol relatively less effective, and acid-formaldehyde, Semesan Bel, Cinnex 20, formaldehyde, and lysol least effective as knife disinfectants for the control of spread of ring-rot in potato tubers. After 2 days of healing-over, the percentabe of ring-rot, when compared with that in lots planted soon after cutting, was not reduced. In the treatment of potato tubers, both before and after cutting, Mercurnol gave better control of ring-rot than did Semesan Bel, Cinnex 20, or hot formaldehyde. There was 65 percent of ring-rot in seed treated before cutting, and but 40 percent in that treated after cutting. The use of whole seed gave 23 percent of ring-rot; slightly infected seed gave 85 percent. The cutting knife spread ring-rot infection to the tenth and last tuber of each lot. When the eyes of healthy tubers were smeared with ring-rot inoculum, infection occurred in 45 percent of the plants. If inoculum was merely rubbed on the sound skin between the eyes, no infection resulted."

Some Evidence on the Spread of Bacterial Wilt (Ring-Rot)

C. H. Metzger and A. M. Binkley
Colorado State College, Fort Collins, Colo.

An attempt was made to answer the question, How much will bacterial ring-rot increase in one season? Using a field of Katahdins that showed $2\frac{1}{2}$ percent of the vines visibly infected with ring-rot, stem smears were made from plants in the immediate vicinity of the visibly affected

plants. It was concluded that although only $2\frac{1}{2}$ percent of the plants were visibly infected in the field, in reality at least 15 percent were infected. In other words, for each diseased potato plant observed, there may have been at least six others that had ring-rot.

The Tuber-Indexing Method for the Detection and Control
of Bacterial Ring-Rot

B. Baribeau, Department of Agriculture
St. Anne de la Pocatiere, Canada

"Conclusions:

"(1) Ring-rot cannot be eliminated by roguing or examination of seed during cutting operation.

"(2) Tubers from fields in which ring-rot occurred should not be used for seed.

"(3) Spread is reduced by planting whole seed.

"(4) Ring-rot can be detected by tuber indexing (growing a single eye from each tuber in the greenhouse ahead of planting time) even in tubers that are apparently healthy.

"(5) Certified seed growers should maintain seed plots in tuber units with seed that has been tuber indexed.

"(6) Table stock growers should plant certified seed.

"(7) All implements used in growing, handling, and grading the crop in which disease occurs and all cellars and bins in which diseased tubers have been stored should be thoroughly disinfected."

Inoculation and Sanitary Precautions to Prevent Ring-Rot

H. N. Racicot, from the Dominion Department of Agriculture, Ottawa, Canada, who did some of the pioneer work on ring-rot in America, was present and contributed some interesting facts. He reported inoculating healthy plants (1) at ground level, (2) in buds at tips of stems, and (3) midway. Only in the case of inoculation at ground level did he get infection in the new tubers.

Racicot thinks much of the so-called field spread is due to lack of sanitation and to spread of contamination in handling seed potatoes. Growers and even investigators do not realize the infectious nature of the disease and the ease with which the bacteria are spread on hands, and implements. He was able to grow two rows alongside each other, one 100 percent diseased, and the other, by carefully washing his hands and observing strict sanitary measures, 100 percent healthy. The knife and picker-type planters are very effective in transmitting the pathogen.

Racicot reported infesting a potato bag in the fall of 1938 by putting several ring-rot-infected tubers in it and shaking them up. After emptying, the bag was kept over winter in a cellar. In the spring of 1939 he put healthy seed pieces in this bag, shook and then planted them. The result was 25-percent infected plants with $6\frac{1}{2}$ -percent diseased tubers at harvesttime.

Suggestions to Growers of Certified Seed Potatoes for
Control of Bacterial Ring-Rot, 1940

1. Use seed lots free from ring-rot. (The most certain sources are regions or localities where ring-rot has not appeared.)
2. Consider planting whole seed.
3. Disinfect seed. Cut seed is being treated in some sections with organic mercury dip.
4. Maintain tuber unit seed plots.
5. Tuber indexing is desirable.
6. Sanitary practices.
 - a. Use new or disinfected bags, crates, baskets, or other containers.
Formaldehyde - 1 pint to 15 gallons of water.
Steam-sterilize old bags if facilities are available.
 - b. Disinfect machinery - planters, diggers, graders, and the like.
Lysol - $2\frac{1}{2}$ tablespoons per gallon of water.
Formaldehyde - 1 pint to 15 gallons of water.
 - c. Disinfect cutting knives and cutting boards.
Formaldehyde - 1 to 15, 70 percent alcohol.
 - d. Disinfect bins, warehouses, cellars, and other storage places.
Bordeaux mixture 5-5-50.
 - e. Provide disinfecting facilities for workers and visitors (to avoid bringing in or spreading contamination).
7. Use caution in obtaining seed from outside sources.
8. Give attention to disposal of diseased tubers and vines.
9. Avoid continuous potato rotations if possible.
10. Avoid overflow of irrigation water from other potato fields.

Suggestions for potato inspectors in avoiding transfer of *Phytophthora* *sepedonica* from one field to another.

1. Disinfect knives with 70 percent alcohol.
2. Disinfect shoes with 70 percent alcohol.
3. Wash hands with soap and water, lysol, or 70 percent alcohol.
4. Some inspectors pull and carry out of field all plants and tubers handled.

REPORT OF THE COMMITTEE TO COORDINATE RESEARCH
ON NEW AND UNUSUAL POTATO DISEASES /1

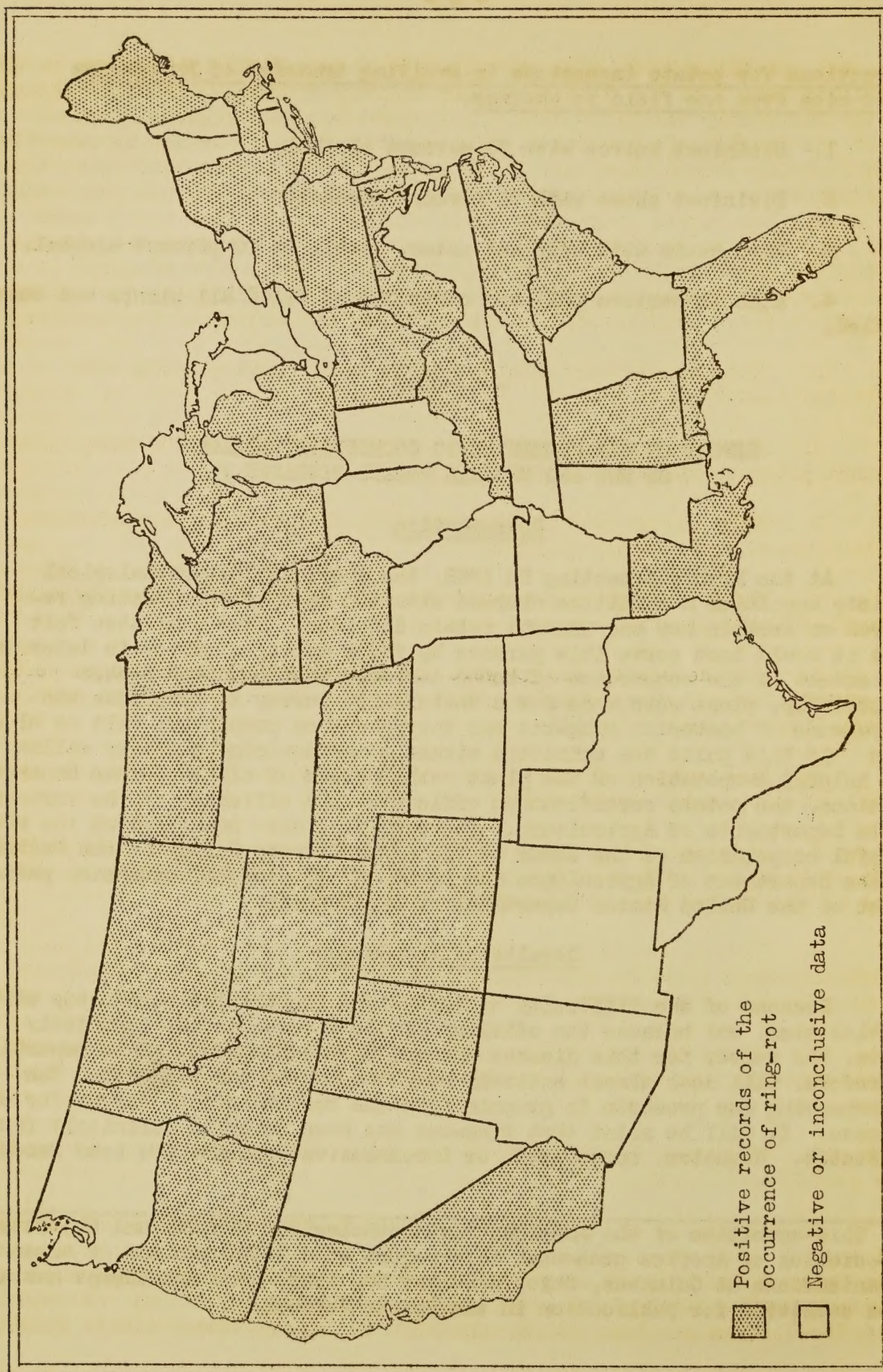
Introduction

At the Richmond meeting in 1938, the American Phytopathological Society appointed a committee charged with the task of coordinating research on certain new and unusual potato diseases. Your committee felt that it could best serve this purpose by first making a survey to determine the extent of the occurrence of these diseases in the United States. Accordingly, plans were made for a Nation-wide survey to determine the prevalence of bacterial ring-rot and the so-called purple top wilt or blue stem. At this point the committee wishes to acknowledge the very willing and helpful cooperation of the plant pathologists of all the State Experiment Stations, the potato certification officials, and officials of the various State Departments of Agriculture. The committee also has received the very helpful cooperation of the staff of the Plant Disease Survey of the United States Department of Agriculture and of Dr. R. J. Haskell, extension pathologist of the United States Department of Agriculture.

Results of the Survey

Because of the difficulty of definitely identifying purple top wilt or blue stem, and because the etiology of the disease is not definitely known, the survey for this disease was not very successful. This report, therefore, will deal almost entirely with the survey for ring-rot. The accompanying map presents in graphic form the results of the survey for this disease. It will be noted that ring-rot has been reported definitely from 27 States. Negative, incomplete, or inconclusive reports have been received

/1 This committee of the American Phytopathological Society and the Potato Association of America presented this report at a joint meeting of these two organizations at Columbus, Ohio, December 30, 1939. The manuscript has also been submitted for publication in the Potato Journal.



Ring-rot of potatoes in U.S.A., 1939

from the remaining 21 States. No attempt has been made in this map to show the distribution of the disease within individual States. A State shaded in the map merely indicates that the disease has been reported from at least one locality in the State. The negative reports do not necessarily mean that the disease does not occur in the State, for in most cases the cooperators have indicated that a very thorough survey had not been made. The survey has served to confirm earlier expectations that the disease would prove to be very destructive. Those who have observed the disease in regions where it is very prevalent uniformly agree that ring-rot is a real threat to potato growing in this country. The following quotations are from letters received by the committee in the course of the survey:

1. "The loss was about 20 percent in one field planted with certified seed."
2. "The loss in one county is estimated at 500 to 700 cars, plus **reduced price on several** thousand cars."
3. "Many fields showed large amounts of this disease, infection in some cases reaching 100 percent."
4. "Tuber rot was very prevalent in 1937 and 1938, the estimated loss being about 25 percent."
5. "In one county the growers are becoming very discouraged because of serious losses. Potato acreage and production has declined 50 percent in the past 3 years."
6. Percentages range all the way from a trace in some fields up to 30 and 40 percent in others."
7. "My opinion of the economic importance of ring-rot in this State is that it will become one of our major diseases. We are amazed at its rate of spread in some of our experimental plots."
8. "Unless drastic measures are taken against contaminated seed stocks, it seems possible that the disease may become a menace to potato growing in this State."
9. "One grower indicated that he was likely to lose about \$10,000 from ring-rot. This fall I learned from fairly good authority that the actual loss was about \$4,000."
10. "Ring-rot is of major importance in this State. The loss in 1939 was probably \$250,000."

Another point of considerable significance is the almost unanimous opinion of those who cooperated in the survey that ring-rot had been introduced into their State on seed stock that had been brought in from some outside source. Although largely circumstantial, there is a great deal of evidence that the disease has been introduced into the United States within relatively

recent years, or else it has suddenly become much more virulent. The former alternative appears most probable. It does not seem possible that a disease of this nature could have been present for very long without having been observed. If this conclusion is correct, we may expect the disease to become more widespread within the next few years unless some effective means of checking its spread is discovered and put into operation at once.

When we give careful consideration to the facts brought out by this survey, it is obvious that the occurrence of ring-rot has a great deal of significance to the potato-certification industry. There is evidence that ring-rot has been distributed from place to place on certified seed as well as on noncertified seed. This places an urgent responsibility on the certification industry to eliminate the disease from its seed stock if it is to maintain the reputation that has been built up by much effort during the past 25 years. In 1938 this Society went on record as recommending the adoption of a zero toleration of ring-rot by all certifying agencies. This recommendation has been adopted by most States, but the application of the rule has necessitated the rejection of an unusually large number of fields inspected for certification. This has naturally worked a great hardship on growers of certified seed, and there has been some agitation for liberalizing this tolerance. Many States have laws requiring that all seed stock offered for sale as such be certified. Some have argued that a rigid enforcement of the zero toleration would limit the available supply of certified seed much below the demand and result in the planting of increased quantities of inferior noncertified seed. This committee has no data on this point, but it feels that the zero tolerance should be maintained until every possible effort has been made to eliminate the disease from seed stock, and until it has been shown that this cannot be done without seriously handicapping the potato industry. Some States already are discussing the possibility of prohibiting the importation of certified seed, requiring growers to use home-grown seed. If the potato growers continue to suffer losses from ring-rot in fields planted with certified seed, the certification industry is likely to receive a set-back, recovery from which will require many years of patient effort.

In view of the known facts about ring-rot, it seems advisable to emphasize the importance of bin inspection in detecting the disease. In some regions where virus diseases have been the only diseases of much importance in certification, bin inspections have been neglected or entirely omitted. It is suggested that certification officials give due consideration to this method of detecting the disease.

The possibility of introducing ring-rot into new localities on seed stock shipped from State to State for experimental purposes should not be overlooked. Every potato research worker should recognize this danger and use all the safeguards possible.

Another point of considerable interest is the ultimate disposition of the seed stock from those fields submitted for certification but rejected because of small percentages of ring-rot. It has been reported to your

committee that in some cases this stock is sold and used for seed purposes, but not as certified seed, the purchaser being willing to take the chance on a small amount of ring-rot, provided the seed is of high quality in other respects. Such a practice, if it becomes general, may defeat the purposes of control through certification.

Although much of the responsibility for controlling ring-rot will fall upon the certification industry, an equal if not greater responsibility falls upon the research worker, for at the present time we do not have sufficient information on which to base an intelligent control program. Because of the critical nature of the problems raised by the presence of this disease, an experimental basis for control is urgently needed, and an adequate research program should be carried out as soon as possible. Because of the widespread prevalence of the disease, the problem is not a local one, and should be investigated in as many parts of the country, and attacked from as many angles, as possible. Research workers in several States have indicated their intention and desire to conduct research in the field of ring-rot control. Several important contributions have been made at this meeting. This committee will be glad to aid in the exchange of information or do anything else that it can to further an adequate program of research, but since the National Potato Project of the United States Department of Agriculture has adequate machinery and facilities for coordinating such a program, this committee feels that it is the logical agency for this service. The committee can be most effective by representing the Society in an advisory capacity.

There has been some confusion in the common names used to designate this disease. It has been called bacterial wilt, bacterial wilt and soft-rot, ring-rot, and the like. Because of the danger of confusion with bacterial wilt (Phytoplasma solanacearum) and soft rot (Erwinia carotovora), this committee believes that it would be desirable to adopt a uniform name; and it believes that "ring-rot" or "bacterial ring-rot" (a direct translation of the German "Bakterienringfaule") is perhaps the most suitable common name for the disease caused by Phytoplasma sepedonica.

The committee has considered the available information about the nature of ring-rot, and its method of spread and possible means of control. It takes the liberty of suggesting a few problems that are in need of immediate attention:

1. A number of years ago, several workers investigated the relative value of disinfecting seed tubers before and after cutting. At that time ring-rot was not a problem, and the conclusions were generally in favor of treating the seed before cutting. It appears that with the appearance of ring-rot the entire question has been reopened. Because of the apparent ease with which ring-rot is spread by means of the cutting knife, the disinfection of cut seed pieces offers a promising means of control. Some of the newer fungicides may be well adapted to the disinfection of cut seed pieces without the usual seed injury.

2. The opinion appears to be rather prevalent that the pathogen of ring-rot does not survive in the soil. However, because of the wide variation in environmental factors in different sections of the United States, it is highly desirable that this question be investigated further. We have practically no experimental evidence for the general assumption that the organism will not survive in the soil.

3. Our evidence on the spread of the disease in the field also is conflicting and inconclusive. It is imperative that we know the extent of field spread and if the disease is spread in the field what agencies are responsible.

4. European workers have stressed the value of planting whole tubers instead of cut seed pieces as a control for ring-rot. A number of years ago, this practice was discouraged in this country because of the increased probability of using virus-infected rubers when small tubers were selected for seed pieces. With the increased efficiency of virus disease control through certification, this objection appears no longer well founded. If ring-rot continues to be a factor, the practice of using whole small tubers for seed purposes may be desirable.

5. The relation of volunteer plants to the overwintering of a pathogen in the field should be investigated. There is some evidence that very lightly affected tubers do not rot in storage and may transmit the pathogen. Similar tubers surviving in the soil over winter may be of considerable importance provided field spread occurs.

6. All available evidence indicates that the pathogen is very highly infectious, which would give added importance to the disinfection of containers storage houses, as well as planting and grading machinery.

7. Several workers have reported to the committee that it is difficult to detect the infection, both in plants growing in the field and in tubers in storage. Infected plants or tubers may show almost no injury, yet the tubers may produce badly infected plants. If seed certification is to be effective, a more accurate method for detecting infection is highly desirable. Investigations of this aspect of the disease might yield results of great importance in ring-rot control.

Educational Problems

Effective control of ring-rot will depend not only upon certification practices and the research program, but will depend also on the effective education of the individual grower as to the danger of ring-rot. It has taken many years to educate potato growers to an appreciation of the control measures that have been recommended for the older and better-known diseases. If the control of this disease is going to necessitate radical changes in our control program, we cannot expect the general farmer to adopt this change without an intensive educational program. We must not forget also that certified seed constitutes only a small proportion of the potatoes that are planted. Much seed stock consists of potatoes sold for table stock, and

the control of the disease in fields where certified seed is not used is going to present a difficult problem. The extension workers in plant pathology will face the problem of presenting new control measures and educating the farmer to a point where he will put them into practice. Because our present control program is only tentative and will probably be modified by the results of research, the extension worker must be constantly ready to modify his recommendations as the experimental evidence justifies.

Conclusions and Recommendations

By way of summary, your committee offers the following conclusions and recommendations:

1. Ring-rot is widely distributed in the United States, but distribution is local in most States.
2. Circumstantial evidence indicates its probably recent introduction and spread throughout the country. Much of this spread can be traced to certified seed. We may expect continued spread in the next few years unless effective measures of control are discovered and put into effect very soon.
3. The disease is highly infectious, has been extremely destructive in certain localities, and is potentially destructive wherever it occurs.
4. The potato-certification agencies have a grave responsibility in preventing further spread and in the control of the disease. The certification industry must be expected to make some sacrifices in the way of strict tolerance to ring-rot unless new evidence justifying more lenient regulations becomes available. It is the opinion of this committee that the zero tolerance for ring-rot should be continued until more information is available to justify its removal.
5. There is urgent need for research leading to effective control of ring-rot. The problem is Nation-wide, and because of the variation in climatic conditions under which potatoes are grown, research should not be confined to a few localities. It is the recommendation of this committee that as many agencies as possible undertake research on the problem. Duplication of some phases of the work and confirmation of results will hasten final conclusions and is desirable.
6. An intensive educational program should be carried out by extension workers to acquaint the potato growers with the dangerous nature of the disease and to further the use of the best control measures available.
7. It is recommended that all research workers recognize the danger of introducing the disease on seed stock used for experimental purposes and use all precautions to prevent such spread.
8. For the sake of uniformity and to avoid confusion, it is recommended that the common name "ring-rot" be adopted for the potato disease caused by Phytophthora sepedonica.

9. In conclusion the committee expresses its appreciation to those who have cooperated in this survey, and offers its services to all interested agencies in fighting the disease on a national scale. It recommends that all interested parties cooperate in every way possible with the National Potato Project in its fight on ring-rot.

Respectfully submitted,

T. P. Dykstra, R. W. Goss, J. G.
Loach, Chairman,
Committee to Coordinate Research
on New and Unusual Potato Diseases.